INSTALLATION MANUAL
FOR
JABIRU 2200 AIRCRAFT ENGINE

DOCUMENT No. JEM2202-5

This Manual is a guide to correctly install the Jabiru 2200 engine into an airframe.

If you have any questions or doubts about the contents, please contact Jabiru Aircraft P/L.

Applicable to Jabiru 2200cc Enginers, S/No. 2068 Onwards (Hydraulic Lifter Type)

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1.2 List of Effective Pages

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6	5	24-6-08	26	5	24-6-08	46	5	24-6-08
7	5	24-6-08	27	5	24-6-08	47	5	24-6-08
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16	5	24-6-08	36	5	24-6-08	56	5	24-6-08
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20	5	24-6-08	40	5	24-6-08			

Issue Notes:

Rev 0	Original Issue
Rev 1	Add photos
Rev 2	Add photos
Rev 3	Re-format
Rev 4	Add pressure differential information
Rev 5	Re-Format

1 Description

1.1 Model

This Manual applies to all Jabiru 2200 Engine Models, but particularly those from S/No 2068 on. Details for operating and servicing are supplied in the Engine Instruction & Maintenance Manual.

Only those details relevant for installation are duplicated below – for all other information please refer to the Instruction & Maintenance Manual.

1.2 Manuals

Instruction and Maintenance Manual

Installation Manual

Parts Catalogue

1.3 Specifications

All information given in this manual assumes static sea level ratings under the following conditions:-

- International Standard Atmospheric conditions at sea level.
- Aircraft service equipment drives unloaded. (Vacuum Pump not fitted)
- Full rich fuel/air mixture.
- Standard Jabiru air filter and hot air mixer box assembly.
- Standard exhaust muffler.
- Jabiru Propeller
- Jabiru Airframe

1.3.1 Ratings

RPM – Maximum (Redline):..... 3300 RPM

RPM – Maximum Continuous:..... 3300 RPM

RPM – Recommended Cruise:..... 2750 RPM – 3100 RPM

Power Rating: ..... 85 hp / 3300 RPM

1.3.2 Fuel

Fuel Consumption:..... 21 L/hr @ Takeoff / Max Continuous Rating

Fuel Consumption:..... 13-15 L/hr @ 75% nominal power setting.

Fuel Pressure to Carburettor Maximum ..... 20 kPa (3 psi)

Fuel Pressure to Carburettor Minimum ..... 5 kPa (0.75 psi)

Recommended Fuel Grade ..... Avgas 100LL & Avgas 100/130

Note: Leaded and Unleaded Automotive Gasoline above 95 Octane RON may be used, however due to the lack of a strong quality control system for automotive fuels Jabiru Aircraft recommend using AVGAS wherever possible.

1.3.3 Oil

Oil Capacity..... 2.3 Litres

Oil – Minimum Temperature for Take-Off..... 50°C (122°F)

Oil – Maximum Peak Oil Temperature ..... 118°C (244°F)

Oil – Maximum Continuous Oil Temperature ..... 80°C – 100°C (176°F - 212°F)

Oil Pressure – Normal Operations..... Min 220 kPa (32 psi)

..... Max 525 kPa (76 psi)

Oil Pressure – Idle ..... Min 80 kPa (12 psi)
Oil Pressure – Starting & Warm Up..... Max 525 kPa (76 psi)
Oil Consumption ..... 0.1 L/hr (max)
Oil Standard ..... Aero Oil W Multigrade 15W-50, or equivalent complying with
..... MIL-L-22851C, or
..... Lycoming Spec. 301F, or
..... Teledyne - Continental Spec MHF-24B

1.3.4 Additives

Note: No Oil or fuel additives should be used. Use of oil or fuel additives will void warranty.

1.3.5 Cylinder Head Temperature (CHT)

Maximum Peak Cylinder Head Temperature[1] ..... 200ºC (392°F)
Maximum Continuous Temperature ..... 180ºC (356°F)

Note: Time with CHT at between 180°C and 200°C is not to exceed 5 Minutes

1.3.6 Exhaust Gas Temperature (EGT)

EGT (Mid-Range / Cruise): ..... Min 680° - 720°C (1256° - 1328°F)
EGT (Above 70% Power): ..... Min 640° - 680°C (1184° - 1256°F)

Note: An EGT gauge is not included as standard equipment on the Jabiru 2200 engine, though a system can be supplied as an option.

1.3.7 Ground Running Limitations

Ground Idle Speed..... 900 RPM (set while engine is hot)
Ground Oil Pressure – Idle / Startup..... Min 80 kPa (11 psi)
..... Max 525 kPa (76 psi)
Ground Oil Temperature..... Max. 100°C (212°F)
Ground Maximum Cylinder Head Temperature..... 180°C (356°F)

Note: If ground temperature limits are reached, shut the engine down or cool it by pointing the aircraft into wind.

[1] Measured with sensor ring fitted under exhaust spark plug.

1.4 Dimensions

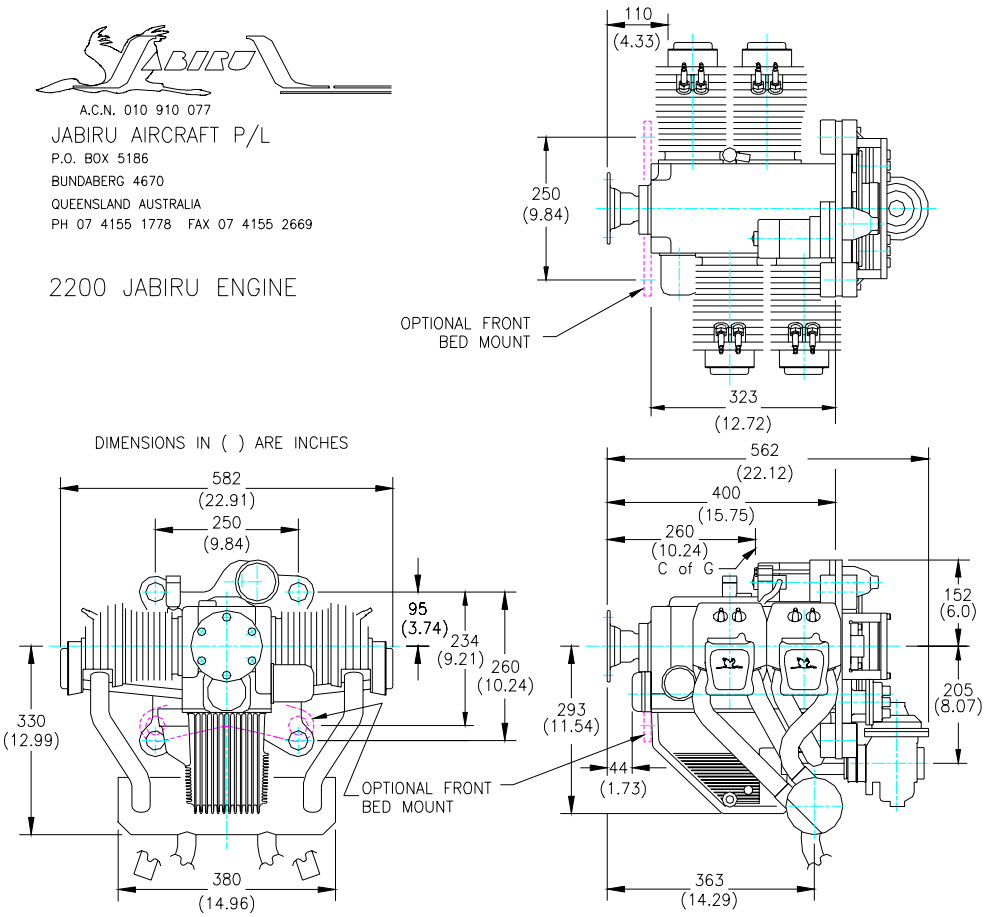

Figure 1. Drawing 9404041/1 Engine Dimensions

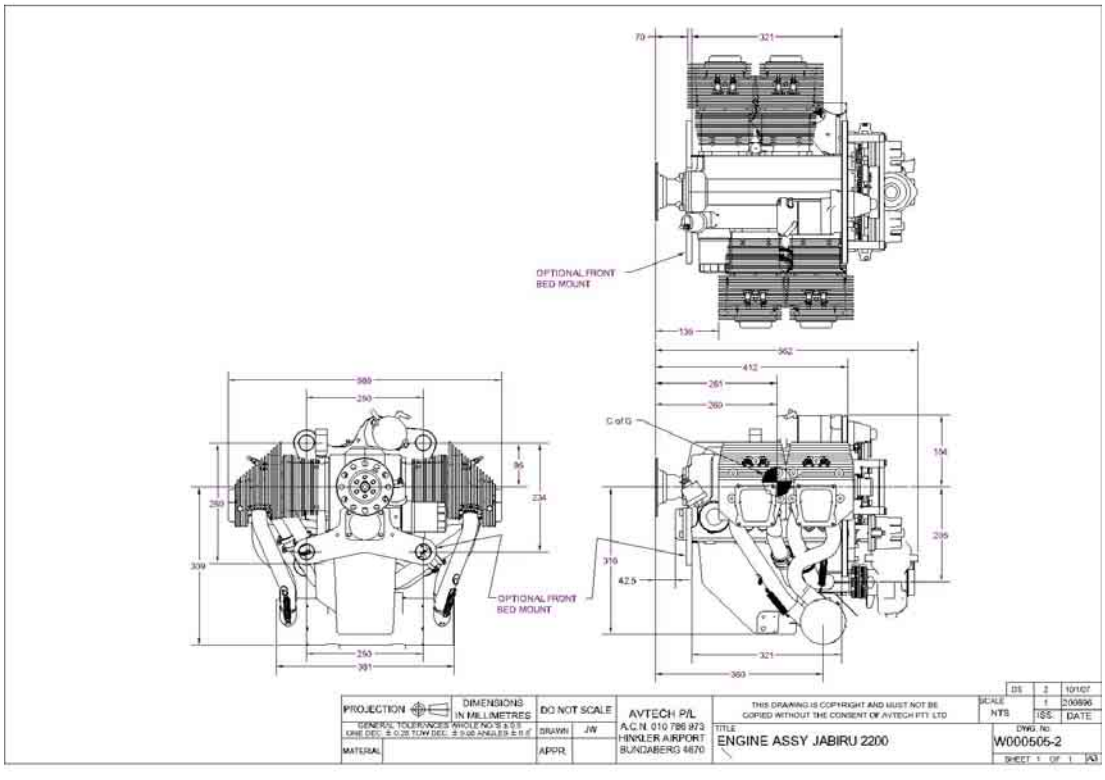

Figure 2. Drawing W000505 – Engine Dimensions S/No. 2553 On

1.4.1 Denomination Of Cylinders

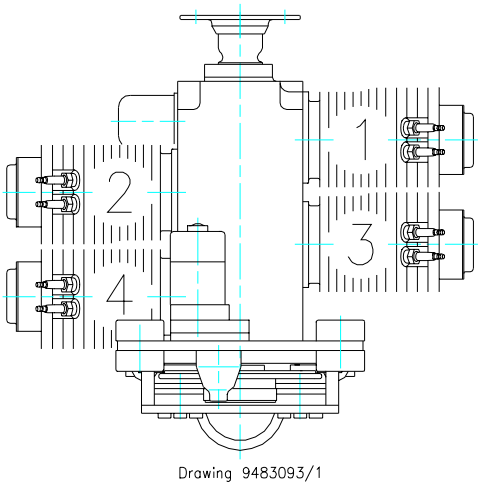

Figure 3. Cylinder Firing Order

Cylinder Firing Order: 1 – 3 – 2 – 4

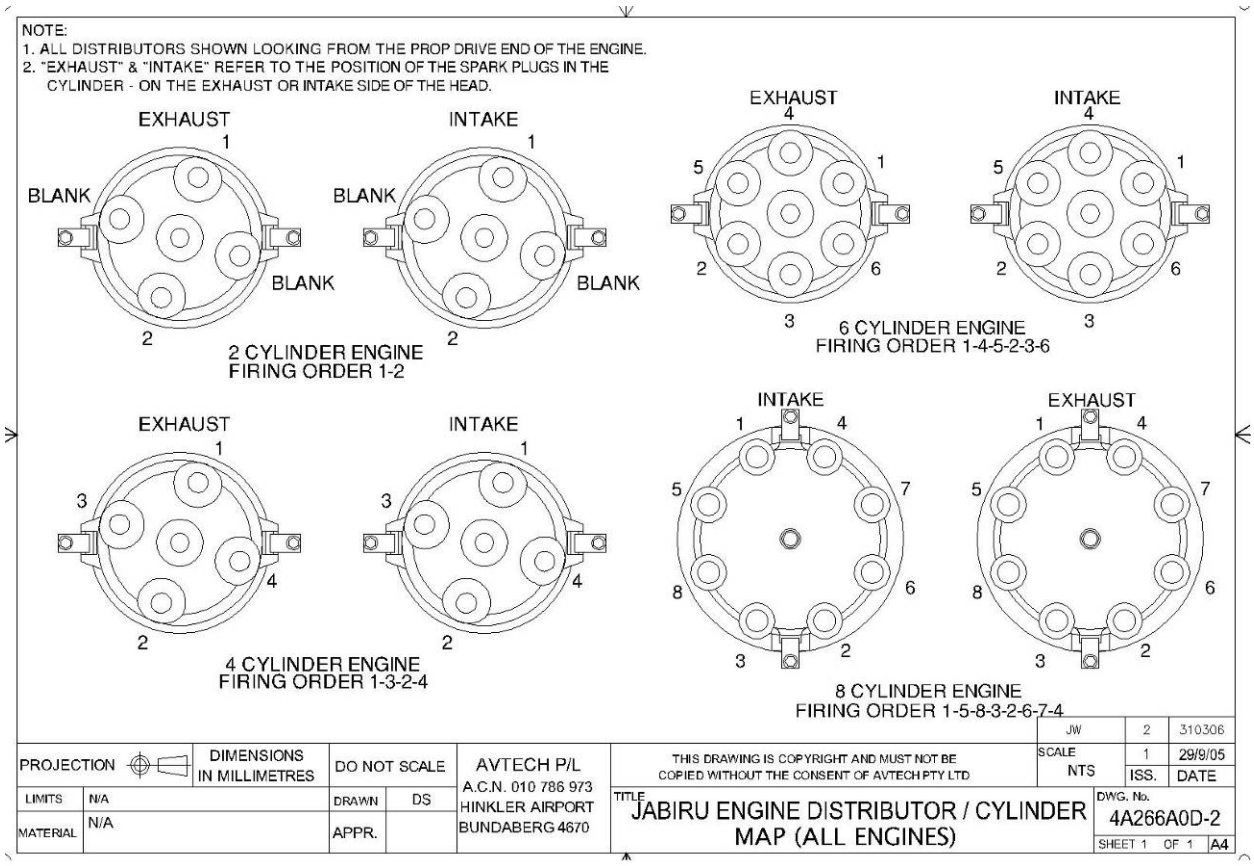

Figure 4. Distributor Cylinder Map

2 Engine Mount

The design of the engine mount must balance many requirements:

- The mount must be strong enough to carry the loads applied by the weight and power of the engine.
- The mount must be stiff enough that the engine does not sag or move too much when power is applied.
- The mount must position the engine at the correct height and angle so that the engine's thrust line suits the aircraft. In most installations, Jabiru Engines need to have their thrust axis offset to the right (tractor installations) by between 1° and 2°.
- The mount must position the engine at the right place. The weight of the engine is a very significant part of the overall aircraft weight, and it's position must be calculated to place the centre of gravity of the aircraft (CG) in the right spot.
- The mount must be designed to allow enough room for the air intake to the Carburettor as well as accessories like vacuum pumps. Access for maintenance must also be considered.
- The final design of the engine mount is a compromise, and sometimes special parts will be required to make it work. Figure 7 shows the installation of a Jabiru 8-cylinder engine into a Van's RV-6. To give a good CG location the engine had to be mounted as close to the firewall as possible. This meant that custom air intake tubes had to be developed to get the intake air to the carburettor with a minimum disturbance and turbulence.

The engine has four engine mounting points located at the rear of the engine (shown in Figure 1 or Figure 2) from which the engine is to be mounted. An optional bed mount may be fitted.

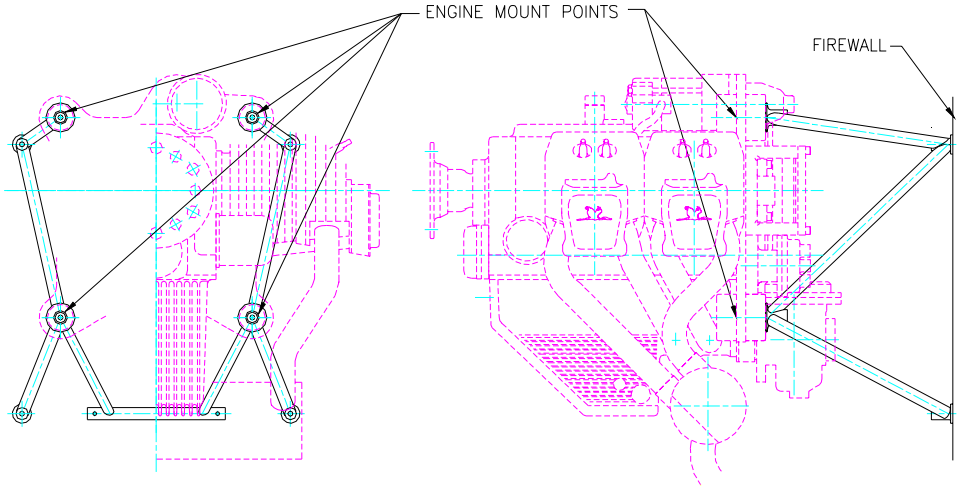

Figure 5. Engine Mount Point Locations

- Each engine mounting point is rubber mounted to damp the engine vibrations. The correct installation of these rubbers is shown below in Figure 5.
- If required, corrections of the engine angle or propeller position can be made by fitting spacers under the rubber cushions. The maximum spacer thickness on any one mount is 3mm.

Figures 6 & 7. Typical Upper Engine Mount, Air Intake Installation

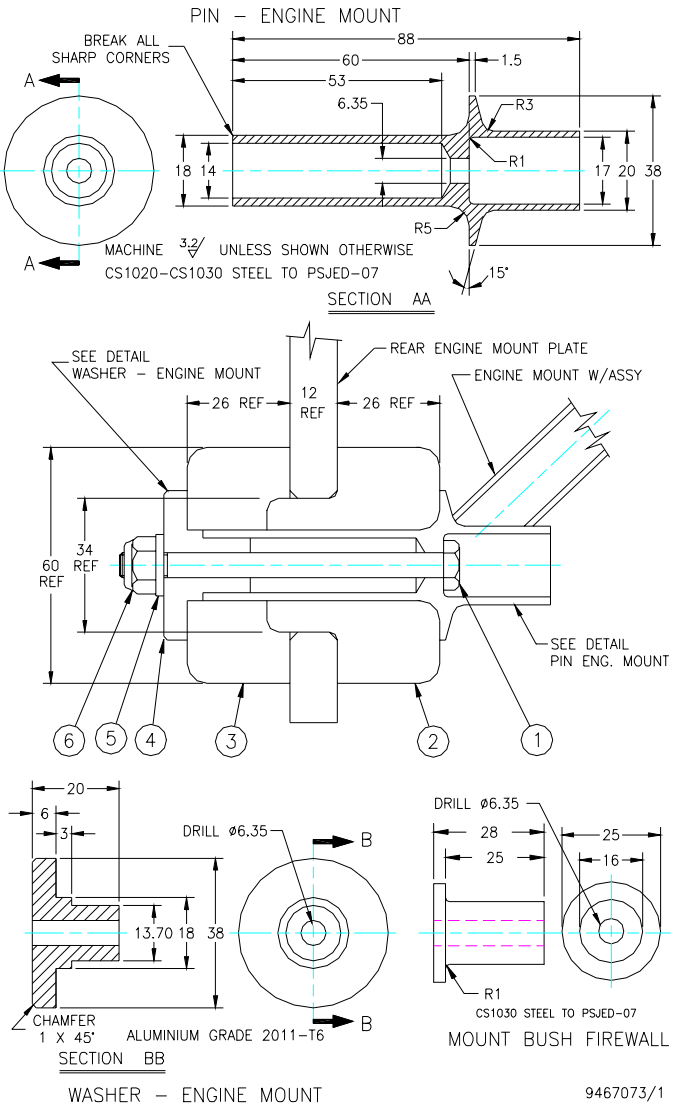

Figure 8 Engine Mount Assembly

3 Controls

This section comprises of the mechanical controls and electrical switches.

3.1 Throttle and Choke

- The throttle and choke cables both attach to the cable mount arm fitted to the carburettor.
- Note: Since a pressure compensating carburettor is used there is no mixture control.
- The cables for the choke and throttle can be adjusted using the adjuster screws and nuts shown in Figure 9. A 7mm spanner is required.
- The cables used must have an adequate radius wherever they turn a corner. Bending the cables too sharply will increase the cable friction, making it difficult to use the control accurately. This is a particular problem for the throttle cable as it will make setting the idle accurately very difficult.
- All Jabiru engines are run-in on a Dynamometer before delivery. It is impossible to accurately set the idle RPM when the engine is on the dynamometer, so the Idle Stop Screw (shown in Figure 9) must be adjusted as a part of the engine installation process.

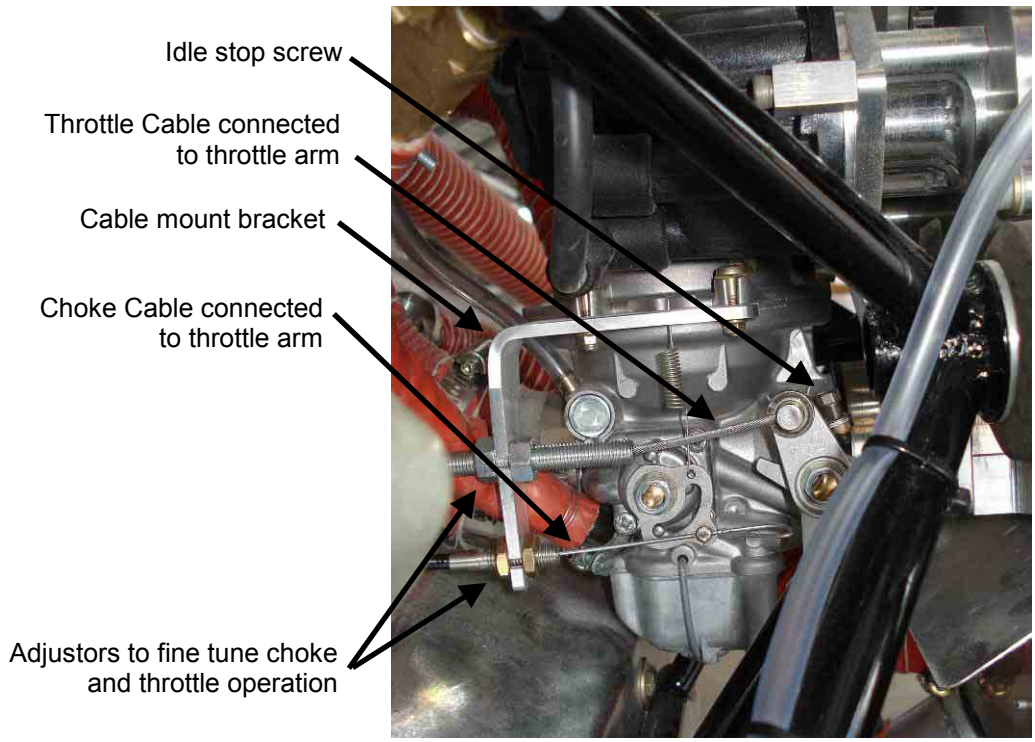
Idle stop screw
Throttle Cable connected to throttle arm
Cable mount bracket
Choke Cable connected to throttle arm
Adjustors to fine tune choke and throttle operation

Figure 9. Choke and Throttle Connections to Carburettor

3.2 Ignition & Starter Systems

- The only electrical controls for the Jabiru Engine are the ignition switching and the start button.
- The ignition switches and starter system wiring are connected as shown by the circuit diagram, Figure 29.
- Section 5 gives details of the electrical systems for the engine.

4 Engine Crankcase Breather, Catch Bottle & Dipstick

- The Jabiru 2200 engine has a crankcase breather connection built into the dipstick housing. This is to be connected as shown in Figure 10 below.
- The catch bottle is designed to catch most oil vapour from the crankcase breather air. It must be monitored in service and periodically emptied of waste oil.
- Figure 58 shows more clearly the outlet from the catch bottle – the catch bottle outlet is secured in the cowl outlet. The position of this outlet and the catch bottle itself must be assessed and oriented so that the crankcase of the engine is exposed to pressure close to ambient. If the breather is open to a high or low pressure (partial vacuum) area the pressure inside the crankcases will also change, with unpredictable effects on engine oil consumption, and oil flow within the engine. This is because several areas of the engine are lubricated via low pressure or spray oil feeds, and drained by gravity – pressure differences cause airflow changes, and modified airflow can significantly affect the oil feeds in these areas.
- Over the course of it's development the 2200 engine has used several different sumps and dipstick lengths. Figure 11 gives an explanation of these lengths and what oil levels should be maintained.
- When installed in a tail-dragger aircraft, re-calibration of the dipstick will be required by the owner so that it can be read accurately with the aircraft sitting on it's wheels.

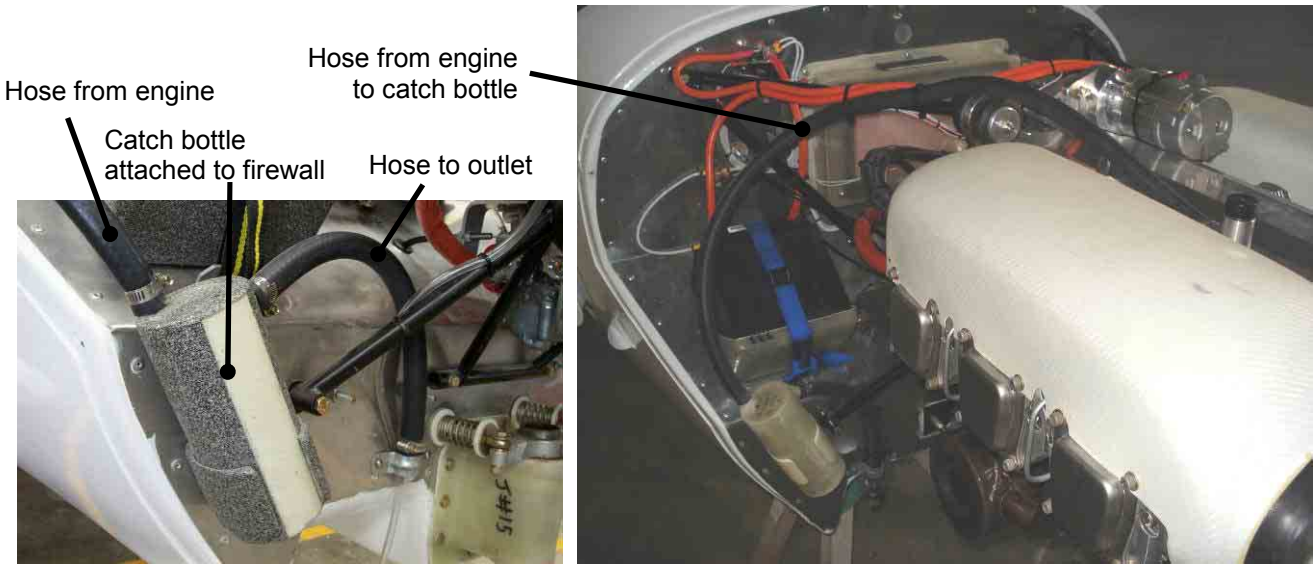

Figure 10. Crankcase Breather Installation

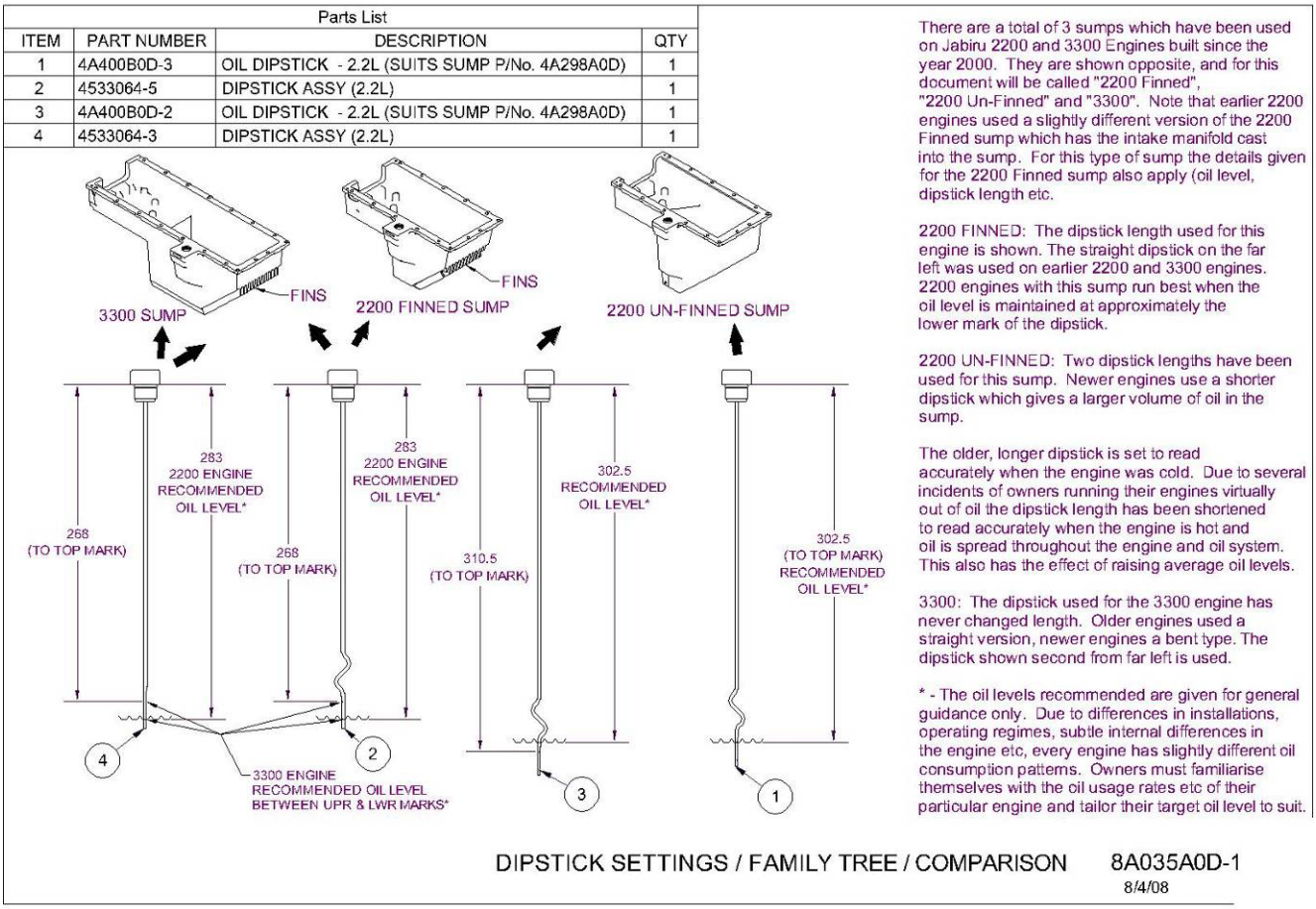
Parts List
ITEM | PART NUMBER | DESCRIPTION | QTY
1 | 4A400B0D-3 | OIL DIPSTICK - 2.2L (SUITS SUMP P/No. 4A298A0D) | 1
2 | 4533064-5 | DIPSTICK ASSY (2.2L) | 1
3 | 4A400B0D-2 | OIL DIPSTICK - 2.2L (SUITS SUMP P/No. 4A298A0D) | 1
4 | 4533064-3 | DIPSTICK ASSY (2.2L) | 1
3300 SUMP
FINS
2200 FINNED SUMP
FINS
2200 UN-FINNED SUMP
268 (TO TOP MARK)
283 2200 ENGINE RECOMMENDED OIL LEVEL*
268 (TO TOP MARK)
283 2200 ENGINE RECOMMENDED OIL LEVEL*
310.5 (TO TOP MARK)
302.5 RECOMMENDED OIL LEVEL*
302.5 (TO TOP MARK) RECOMMENDED OIL LEVEL*
4
2
3
1
3300 ENGINE RECOMMENDED OIL LEVEL BETWEEN UPR & LWR MARKS*
There are a total of 3 sumps which have been used on Jabiru 2200 and 3300 Engines built since the year 2000. They are shown opposite, and for this document will be called "2200 Finned", "2200 Un-Finned" and "3300". Note that earlier 2200 engines used a slightly different version of the 2200 Finned sump which has the intake manifold cast into the sump. For this type of sump the details given for the 2200 Finned sump also apply (oil level, dipstick length etc.
2200 FINNED: The dipstick length used for this engine is shown. The straight dipstick on the far left was used on earlier 2200 and 3300 engines. 2200 engines with this sump run best when the oil level is maintained at approximately the lower mark of the dipstick.
2200 UN-FINNED: Two dipstick lengths have been used for this sump. Newer engines use a shorter dipstick which gives a larger volume of oil in the sump.
The older, longer dipstick is set to read accurately when the engine was cold. Due to several incidents of owners running their engines virtually out of oil the dipstick length has been shortened to read accurately when the engine is hot and oil is spread throughout the engine and oil system. This also has the effect of raising average oil levels.
3300: The dipstick used for the 3300 engine has never changed length. Older engines used a straight version, newer engines a bent type. The dipstick shown second from far left is used.
* - The oil levels recommended are given for general guidance only. Due to differences in installations, operating regimes, subtle internal differences in the engine etc, every engine has slightly different oil consumption patterns. Owners must familiarise themselves with the oil usage rates etc of their particular engine and tailor their target oil level to suit.
DIPSTICK SETTINGS / FAMILY TREE / COMPARISON 8A035A0D-1
8/4/08

Figure 11. Dipstick Family Tree

5 Electrical Equipment

5.1 Alternator

- The alternator fitted to the Jabiru 2200 engine is a single phase, permanently excited with a regulator.
- The rotor is mounted on the flywheel and the stator is mounted on the alternator mount plate at the back of the engine. The alternator mount plate is also the mount for the ignition coils and the vacuum pump.
- Note: The electrical system is Negative Earth

Specifications

Power (Max): 120W Continuous (Up to Engine S/No. 2661)
Power (Max): 200W Continuous (Engine S/No. 2662 onwards)

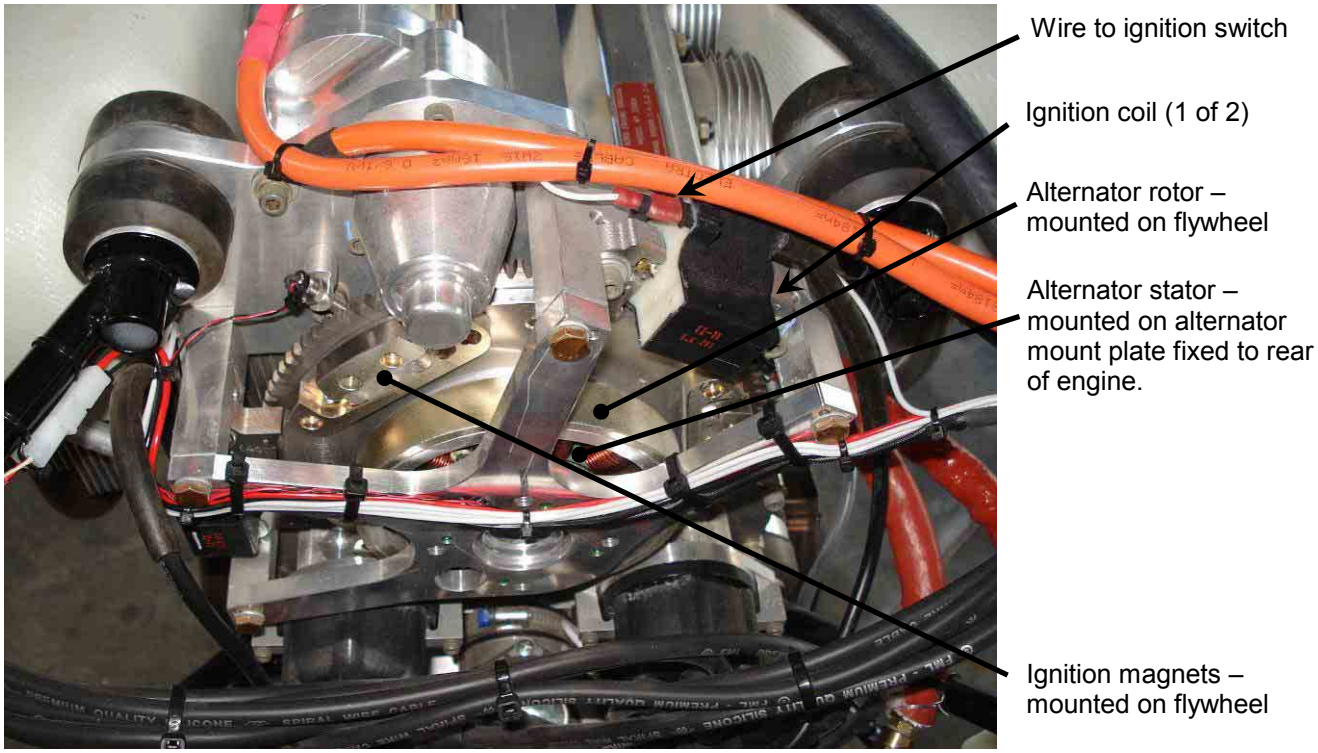
Wire to ignition switch
Ignition coil (1 of 2)
Alternator rotor – mounted on flywheel
Alternator stator – mounted on alternator mount plate fixed to rear of engine.
Ignition magnets – mounted on flywheel

Figure 12. Ignition & Alternator Detail

5.2 Regulator

- The regulator has been selected to match the voltage and current of the integral alternator. Only Jabiru Part No. PI10652N should be used. (The regulator output voltage is 14 volts + 0.8 volt.).
- Recommended wiring of regulator is positive and negative of the regulator directly to the battery. A 20A fuse or circuit breaker may be used between the regulator & battery
- The regulator is equipped to illuminate a Low Voltage Warning Light. Refer to Figure 14 for plug pin details.

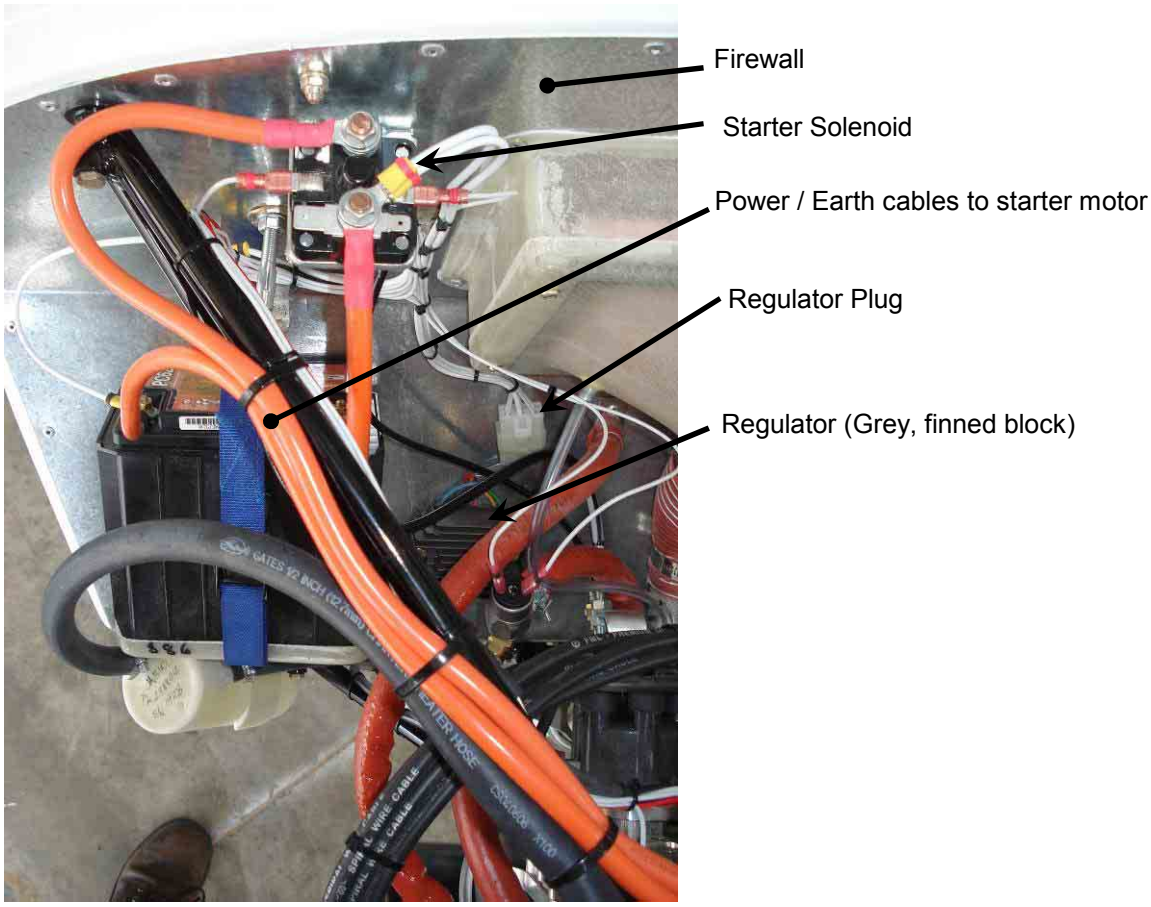

Figure 13. Electrics Installation to Firewall

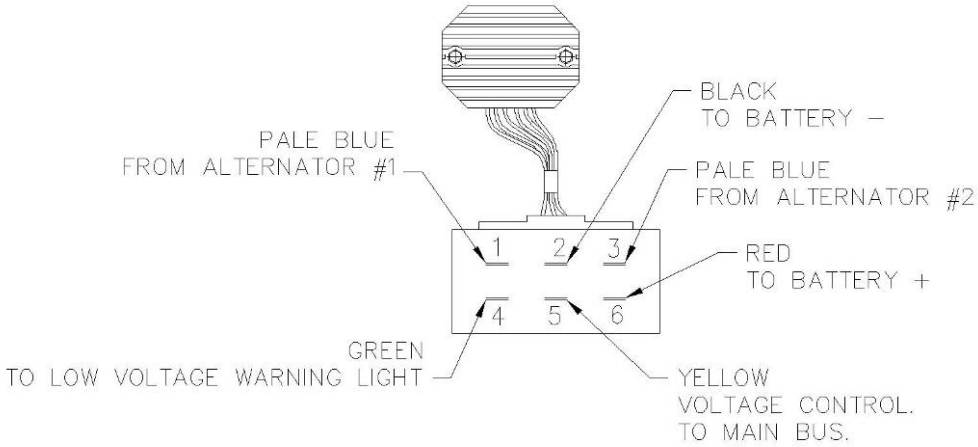

Figure 14. Regulator Plug Wiring Details

5.3 Ignition

- The ignition unit has dual breakerless transistorised ignition with the magnets mounted on the flywheel and the coils mounted on the alternator mount plate. Figure 12 shows the coils of a Jabiru 6-cylinder engine. For the 2200 engine the system is the same, however the position of the coils and the magnets on the flywheel are slightly different.
- The current from the coils flows to the distributor from where it is distributed to the spark plugs.

- The ignition is turned OFF by grounding the coils via the ignition switches. This is the reverse of most electrical systems: when the ignition switch is in the open (not connected) position the coil is LIVE and will fire. Wiring details are shown in Figure 28.
- The ignition is timed to 25° BTDC. Ignition timing is fixed – it is set by the position of the flywheel magnets relative to the crankshaft.
- The temperature limit for the ignition coils is approximately 70°C. This should be checked by the installer. It is recommended that pipes of 12mm dia be fitted to the top rear of each air duct directing air onto the coils for cooling purposes.
- Coil gaps are set at 0.25mm to 0.30mm (0.010" to 0.012").
- When installing new ignition coils the output leads go in the directon of prop rotation. RHS coil output lead is up LHS coil output lead goes down – See Figure 12.

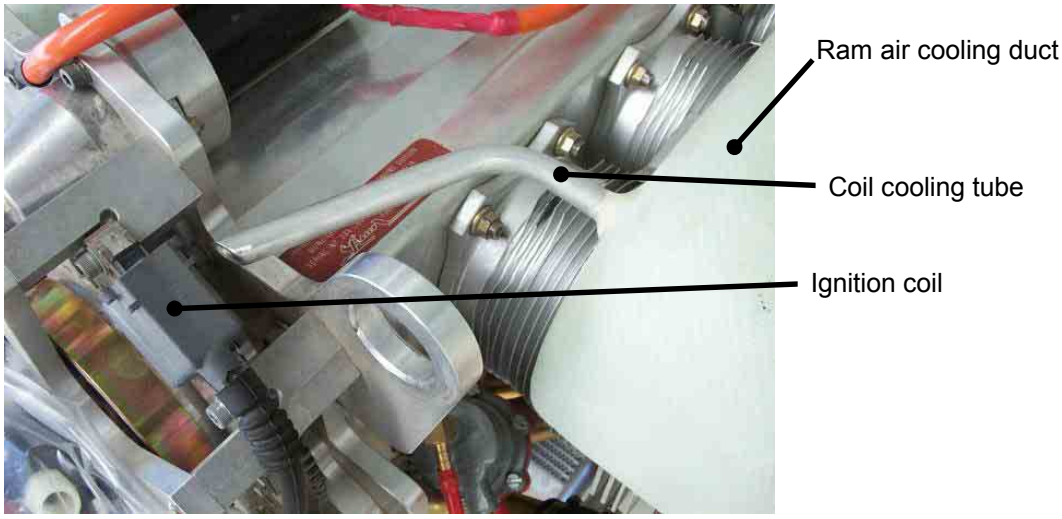

Figure 15. Ignition Coil Cooling Tube

5.4 Starter Motor

- The starter is mounted on the top of the engine and drives the ring gear on the flywheel.
- The motor is activated by engaging the starter button (the master switch has to be ON) which trips the solenoid, hence current flows from the battery to the motor.
- The cable from Battery to starter should be minimum 16mm^2 copper.
- Wiring details are shown in Figure 28.

5.5 Starter Solenoid

- The starter Solenoid is mounted on the firewall as shown in Figure 13.
- The Solenoid body forms a part of the electrical circuit and MUST be earthed to function correctly.

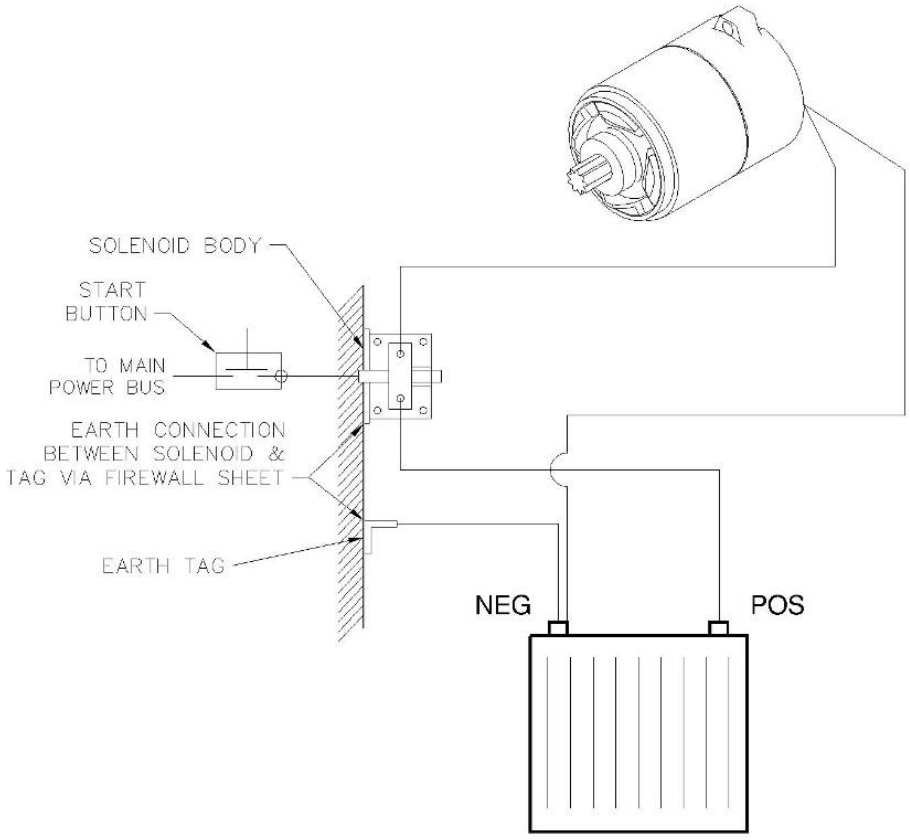

Figure 16. Starter Wiring Details

5.6 Battery

- The battery should be of a light weight, 12V, 20 Ah type able to accept a charging voltage up to 14 V (+ 0.8V) and a 30 AMP Input.
- For optimum starting the battery used must have a high Cranking Amp Capacity (also known as Pulse Amp Capacity). The standard battery used by Jabiru Aircraft has a Pulse Amp rating of 625 Amps. Batteries with higher Pulse Amp ratings may be used and will improve engine starting in colder climates.

5.7 Wiring Practices

- Using aircraft grade wiring is strongly recommended. Compared to other grades of wire aircraft grade can carry higher currents for the same physical size and weight. The insulation used on aircraft grade wire is also frame resistant and is designed for better resistance to damage caused by chaffing or rubbing.
- Care should be taken to identify each wire via labels or similar. This makes troubleshooting electrical issues much easier.
- Wherever possible wires should be identified as carrying “Power” or “Earth”. This can be done by using different colour connectors or applying rings of coloured heat-shrink during assembly. Again, this step simplifies troubleshooting or later modification.
- Wires should be laid out in bundles and supported along their length to prevent failures due to fatigue.

5.8 Instruments

5.8.1 Electronic Tachometer

- General wiring information for the Tachometer is given in the Wiring Diagram, Figure 28. Detailed instructions on it's installation are supplied by the instrument manufacturer.
- The tachometer picks up on 2 metal tabs attached to the inside of the flywheel.
- The Pickup used is a Magnetic Induction sender type. It is a passive device requiring no external power.
- They Pickup outputs a voltage in response to variations in their self-induced magnetic field caused by proximity to moving ferrous metal parts (such as the tags fitted to the rear of the flywheel).
- The Tachometer sender must be adjusted to have approximately a 0.4mm gap between the tip of the sender and the tag. Note that due to normal bearing clearances the crankshaft moves slightly when the engine is running, so if this gap is set too small the sender will hit the tag. The sender is fragile and most times damage like this means that the sender must be replaced. If the gap is different for each of the two tags then one tag can be carefully bent to be the same as the other.
- Ensure gauge is reading correctly. While large errors will be obvious, smaller errors are harder to pick and it is recommended to check the gauge reading with another instrument (such as a hand-held optical prop-tach).

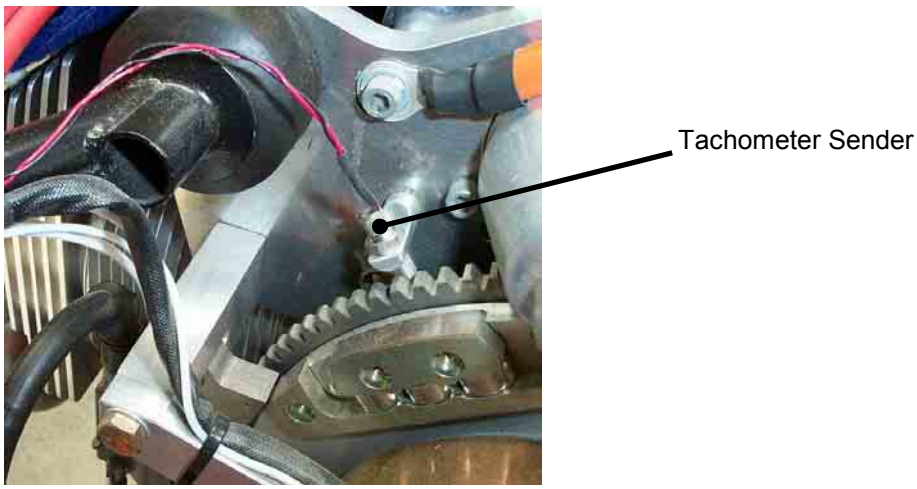

Figure 17. Tachometer Sender Installation

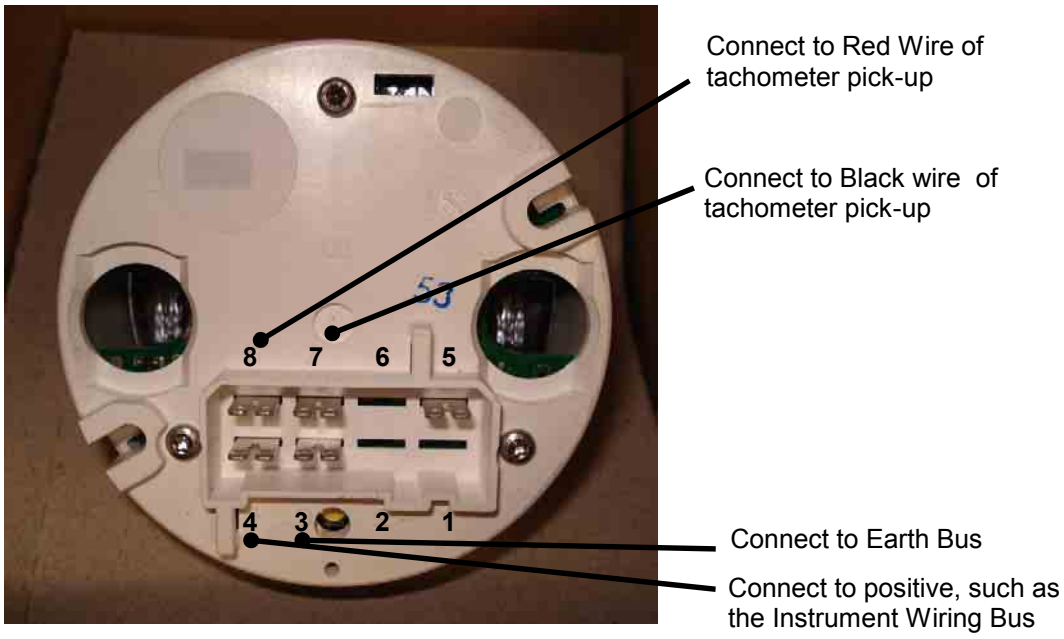

Figure 18. Tachometer Connections

5.8.2 Oil Temperature Gauge

- The Oil Temperature Gauge uses an electric probe mounted in the base of the sump. Jabiru Part No. PI10752N is recommended.
- The gauge has 3 pins, one marked "+" – which is connected to power, one "S" – which is connected to the sensor and one un-marked – which is connected to earth.
- The temperature sender is a brass fitting installed in the engine sump beside the drain plug.
- The oil temperature relies on a good earth connection between the sensor, the engine and the airframe earth terminal. If there is excess resistance at any of these points gauge reading errors will occur.

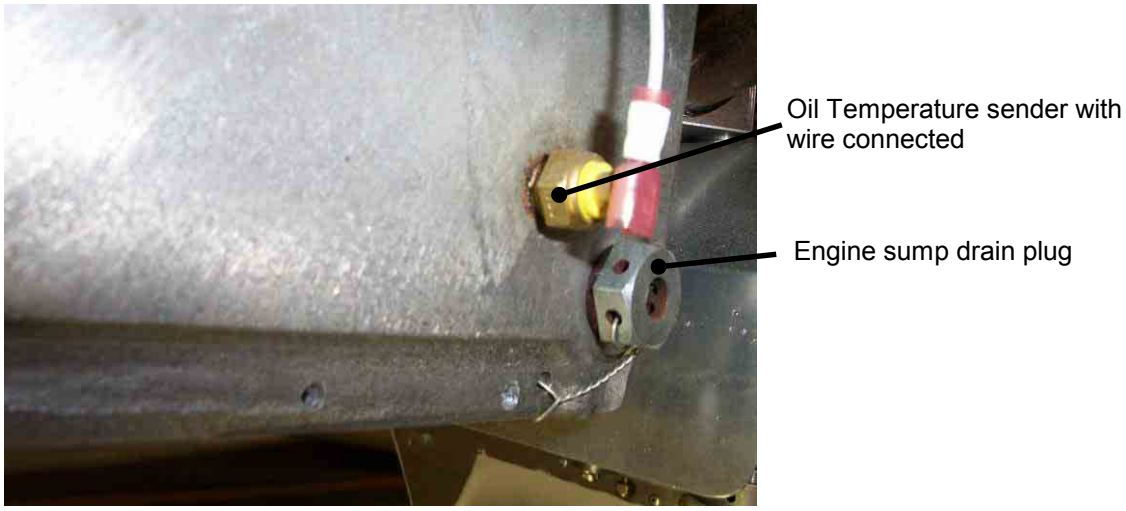

Figure 19. Oil Temperature Sender

Figure 20. Oil Temperature Connections

5.8.3 Oil Pressure Gauge

- An electric oil pressure sender is fitted to the engine for an Oil Pressure Gauge. Jabiru Part No. PI10762N is the recommended gauge.
- The gauge has 3 pins, one marked "+" – which is connected to power, one "S" – which is connected to the sensor and one un-marked – which is connected to earth.

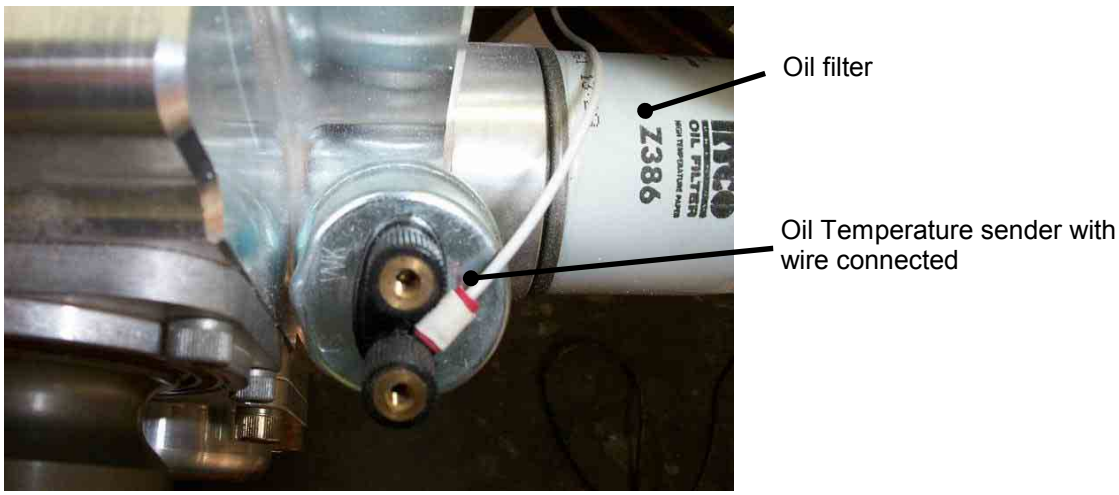

Figure 21. Oil Pressure Sender

Figure 22. Oil Pressure Connections

5.8.4 Voltage Gauge (Optional)

- A voltage gauge can be connected to the aircraft systems.
- The gauge has 2 pins, one marked "+" – which is connected to power and one un-marked – which is connected to earth.

Figure 23. Voltage Gauge Connections

5.8.5 Cylinder Head Temperature Gauge

- The Cylinder Head Temperature Gauge uses a thermocouple which is installed to the exhaust spark plug of the hottest cylinder of the engine.
- The head temperatures of air cooled engines are typically quite variable – differences of 50°C (90°F) between the hottest and coolest head are not uncommon. Refer to Section 13 for additional information on cooling.
- For a new installation an audit must be done to establish which is the hottest cylinder. The CHT thermocouple probe is then fitted under the exhaust spark plug on that cylinder. Cylinder number 4 often runs hottest in normal tractor installations, however for new installations this MUST be checked and confirmed. Jabiru Part No. PI10732N is the recommended gauge.
- Care must be taken when installing the spark plug terminal – the terminal must be aligned with the spark plug. If the terminal is not aligned the spark plug seal will be poor and hot combustion gasses can leak out. These very hot gases will cause the thermocouple to mis-read and show high CHT's. Figure 25 shows properly and improperly fitted CHT terminals.
- Loom and Thermocouple sensor are supplied with the instrument. These must be installed as per the instrument manufacturer's directions. If cable is too long it must be looped as many times as necessary and strapped behind the instrument panel.

DO NOT CUT TO LENGTH

The Thermocouple sensor works by reading small voltages generated by the sensor wires, and cutting the wire upsets the instrument's calibration.

- Ensure that wire is not chaffing on the fibreglass air duct or cooing fins.
- No power connection is required – the instrument reads directly off the voltage created by the thermocouple wire.
- Temperature of the cold junction for best results should be around 50ºC. Ensure cold junction is mounted as far from the thermo couple probe as possible.

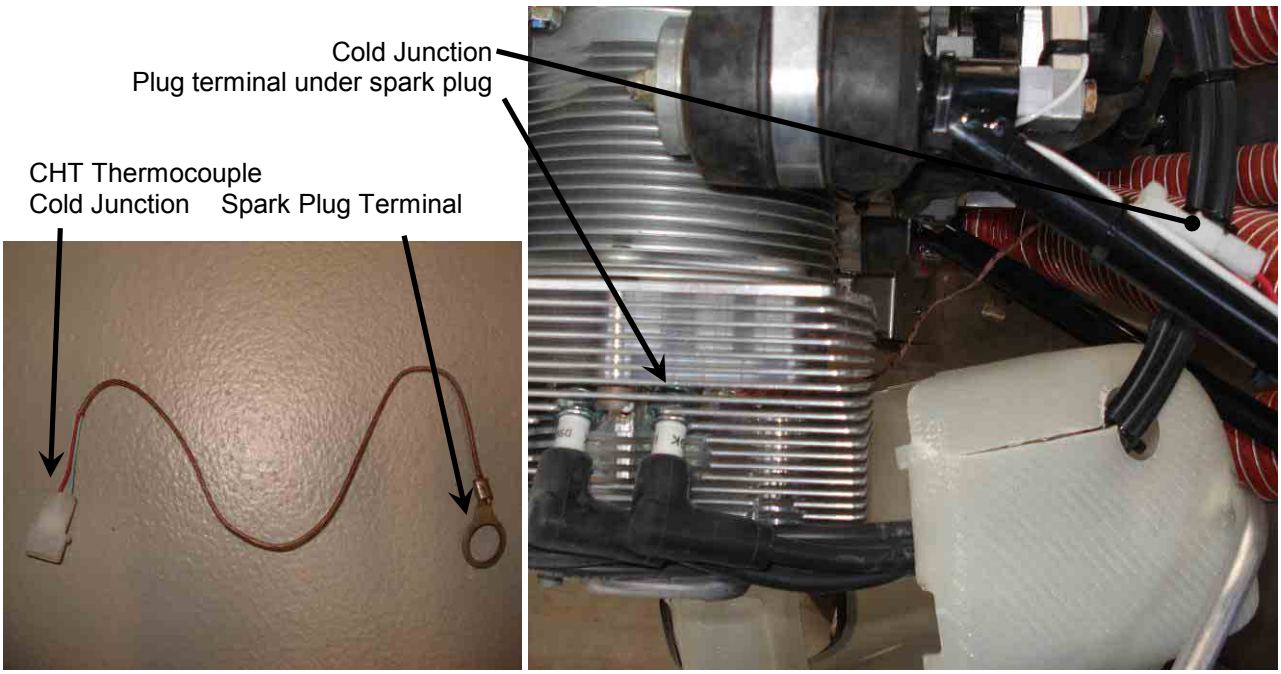

Figure 24. CHT Sender (Thermocouple) Installation

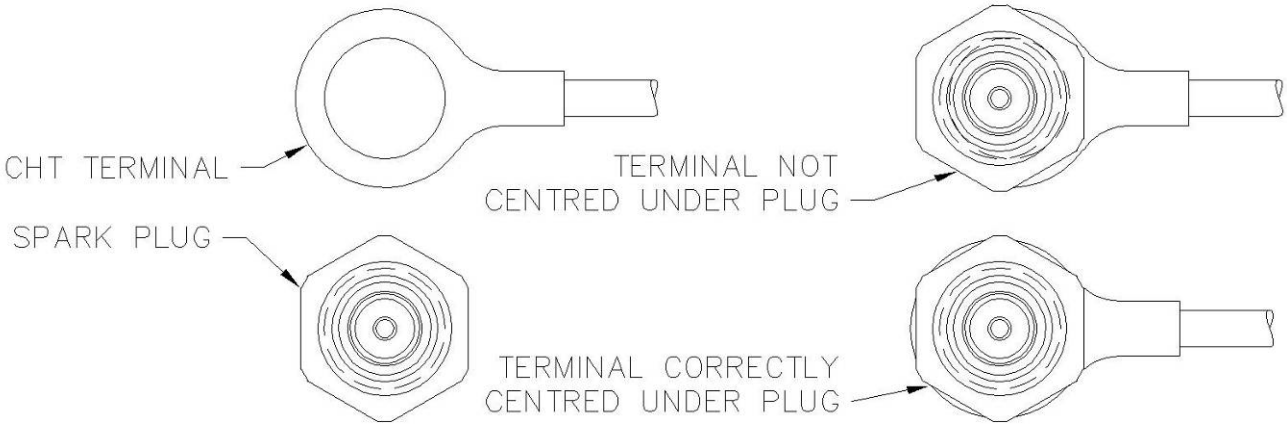

Figure 25. CHT Terminal Installation

Figure 26. CHT Gauge Connections

5.8.6 Exhaust Gas Temperature Gauge

- An optional Exhaust Gas Temperature Gauge can be fitted. The probe should be positioned 100mm from the port flange on the exhaust pipe of a convenient cylinder. Jabiru Part No. PI0325N is the recommended gauge.

5.9 Radio Frequency (RF) Noise Reduction

- RF noise is a common problem with aircraft. Symptoms include:
  - i. Radio squelch setting needs to be high
  - ii. Excess noise in the background during transmissions
  - iii. Squeals or other feedback noises heard during transmission
  - iv. Intermittent static or noise breaking through the squelch.
- RF noise is a complex problem and is influenced by many different factors. The following points do not contain everything there is to know about RF noise, but they are given as recommendations of general good practice to minimise it's effect.
- Ensure all connections, particularly engine earths, are clean and un-corroded.
- If the aircraft has a metallic firewall it can be used as a shield to block the majority of RF noise. To be most effective any wire that passes through the firewall should be fitted with a Ferrite Bead (also known as a Suppressor or RF Suppressor). Bundles of wires can have a single large Suppressor fitted rather than a

Suppressor for each wire. The wiring diagram in Figure 28 shows suppressors in schematic form. These suppressors are readily available at local electronics stores.

- A Noise Filter can be fitted to the radio's power supply. Again, these filters are readily available from local electronics stores. The manufacturer's instructions must be followed for installation.
- Cables passing through the firewall (such as throttle cables, choke, carburettor heat and cabin heat cables) can transmit RF noise back into the cabin. This can be minimised by earthing the cables at ONE end. On the Jabiru Engine an earth wire (Shown in Figure 29) is provided connecting the carburettor to the rest of the engine, so the throttle and choke cables are connected to earth through this wire.
- It is normal & unavoidable that the engine's ignition system produces some RF noise. This can be minimised by:
  - i. Ensuring all spark plug gaps are set properly.
  - ii. Ensure ignition coil gaps are set properly
  - iii. Ensure all high-tension leads (Spark plug leads) are firmly fitted at both ends – to the spark plug and to the distributor. In addition, the lead from each ignition coil to the distributor must be firmly fitted to the distributor.
  - iv. Ensure Distributor caps and rotors are in good condition.
- To counteract RF noise, Jabiru Aircraft run shielded wiring on all radio and intercom wiring. In our experience, the "Earth Return" method of shielding (where the shield for the wire is also used to form the earth connection) does not work as well as the "Faraday Cage" (where the shield is a shield only – it is not a part of the circuit) method of shielding
- "Earth Loops" – where a wire is connected to earth at both ends – can introduce RF noise into the system. All shields should be connected to the aircraft's earth system at one end only.
- The cable used for the Antenna should be high quality, such as RG400 (Shown in Figure 27). This cable has a double layer of shielding and better RF insulation than other cable types. Note that the coaxial cable included in most antenna kits tends to have a single layer of insulation. BNC connectors are recommended for most applications, and wherever possible crimped connectors which require a special crimper to assemble should be used. Crimped connectors are much less prone to RF leakage or assembly issues than other types (such as screw-together BNC connectors).
- Wires and antenna cables must be routed carefully. Bending or coiling Co-axial cable (such as is used for antennas) sharply will significantly degrade the cable's RF shielding and must be avoided wherever possible. Coiling antenna cables or any wire carrying current (sensor wires carry very low current so are generally exempt from this requirement) into loops can induce RF noise in other systems. GPS antennas in particular are powered – both the antenna and any excess antenna cable must be positioned carefully, as far away from the radios, antennas and intercom as possible.
- While not a part of the engine installation, strobes can produce significant RF noise. Most brands of strobes require that the box containing the strobe head unit electronics is earthed, and this is essential to minimise noise. The cables used for the strobe lights themselves must be shielded and the shield must be earthed properly, at ONE end only. The Box containing the strobe electronics can also be installed on the engine side of the firewall to further reduce RF noise. The strobe unit's manufacturer normally provides good instructions for minimising their effect on radio noises.

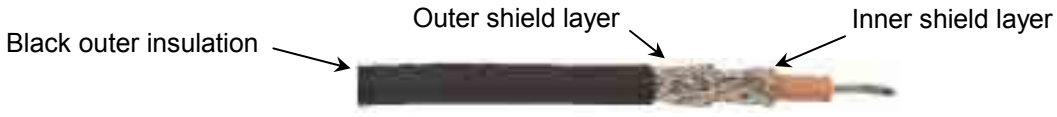

Figure 27. RG400 Co-Axial Antenna Cable

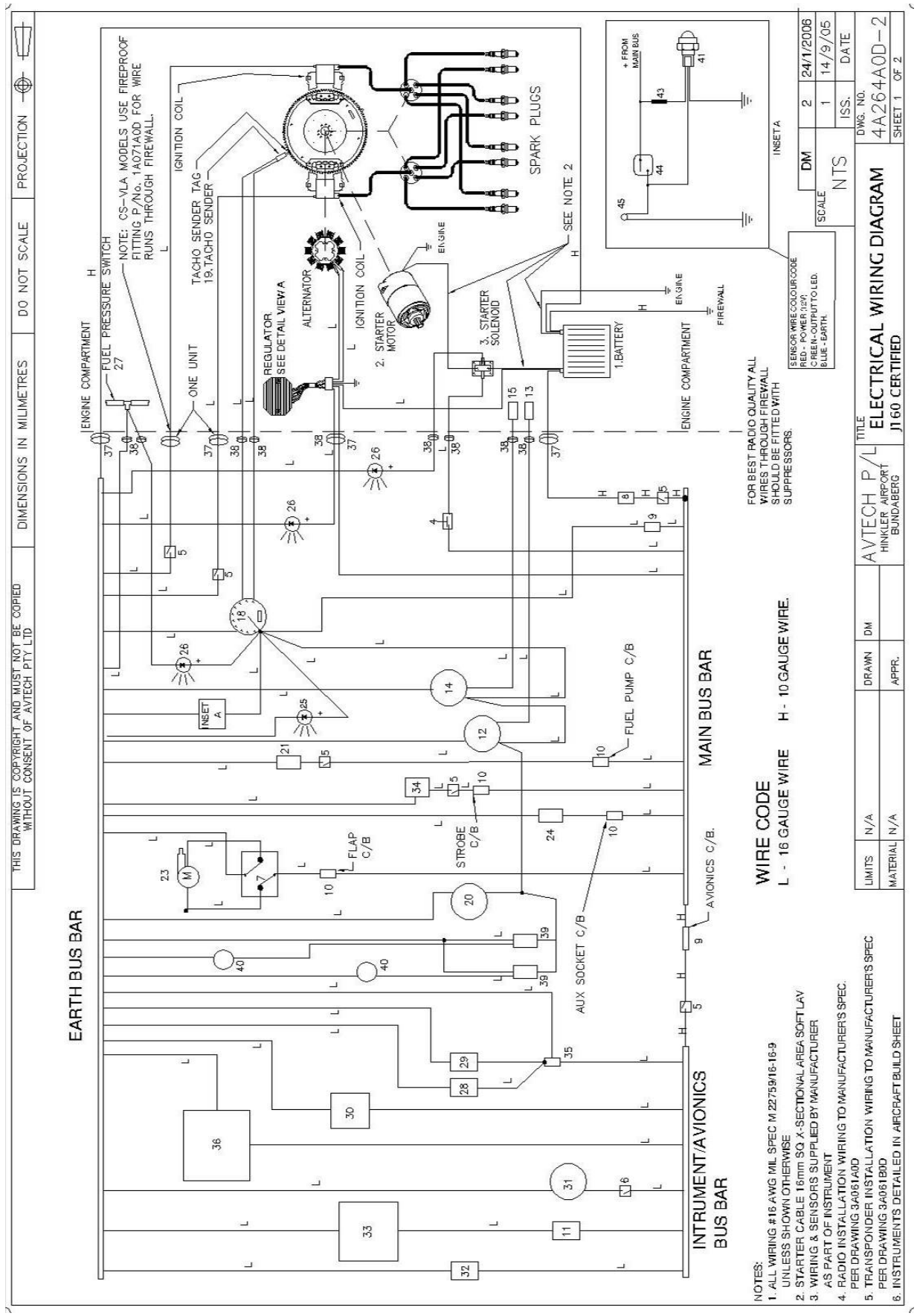

Figure 28. Wiring Diagram

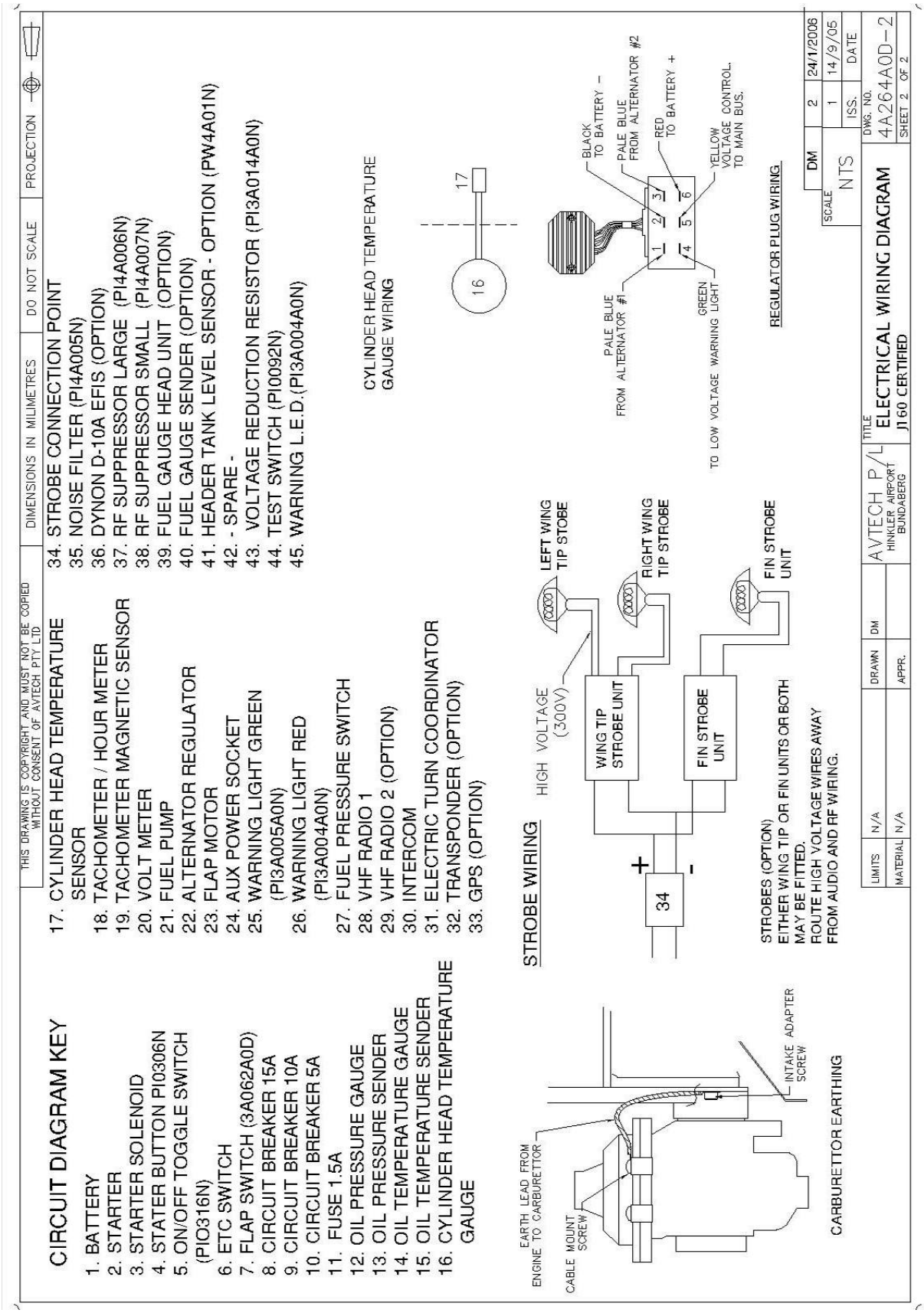

Figure 29. Wiring Diagram Key